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COLLABORATIVE RECOMMENDER SYSTEM FOR ONLINE JEWELRY STORE

MORRIS HON MAO NING

This project is submitted
in partial fulfilment of the requirements for a
Bachelor of Science with Honours
(Cognitive Science)

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The project entitled ‘Collaborative recommender system for online jewelry store’ was prepared by Morris Hon Mao Ning and submitted to the Faculty of Cognitive Sciences and Human Development in partial fulfillment of the requirements for a Bachelor of Science with Honours (Cognitive Sciences)

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(AHMAD SOFIAN SHIMINAN)

Date:

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ABSTRACT

The existence of vast amount of data exist in internet nowadays has become a dilemma in the field of electronic commerce. Searching of the desired information has become so inconvenient since there are too many irrelevant information exist all over the shopping platform. One of the most popular solution nowadays to solve this dilemma is recommender system. Recommender systems are now pervasive in user's lives. They aim to help users in finding items that they would like to buy or consider based on huge amount of data collected. Parsing a huge amount of data to predict user's preference base on his or her similarity with other group of users is the core of recommender system. One of the famous approach that could be applied to the implementation of recommender system is collaborative filtering approach. The motivation to do this project comes from my eagerness to improve my web developing skill especially in the field of jewelry e-commerce and to get a deep understanding of recommender system. In this project, a prototype of online jewelry selling store with the implementation of a collaborative filtering based recommender system was developed. The algorithm under collaborative filtering approach that been used in this project is called slope one algorithm which basically works by predicting user's preference based on other user's rating history on specific items in the system. Finally, the prototype built in this project was evaluated in term of the performance of the recommender system under user's point of view and the results of evaluation was discussed in details to draw out a conclusion for its further improvement.

Keywords: recommender system, e-commerce, collaborating filtering, slope one, jewelry

ABSTRAK

Kewujudan data yang berjumlah besar di Internet kini merupakan salah satu dilemma yang membimbangkan dalam bidang perdagangan electronik. Proses untuk mendapatkan maklumat yang dikehendaki telah menjadi begitu susah kerana maklumat yang tidak releven terlampau banyuk di seluruh platform beli-belah. Salah satu care yang terkini untuk menyelesaikan dilema ini adalah penggunaan sistem pencadang. Teknologi system pencadang kini telah digunakan secara meluas dalam kehidupan pengguna. Fungsi utamanya adalah untuk membantu pengguna mendapatkan barangan yang berkemungkinan diambil pertimbangan semasa membeli barangan secara online berdasarkan data yang telah dikumpul. Dengan menggunakan data yang berjumlah besar ini, sistem pencadang dapat membina hubungan antara pengguna dan membuat ramalan tentang minat setiap pengguna. Antara satu cara untuk membina sistem pencadang seperti ini ialah ‘collaborative filtering’. Motivasi untuk melakukan projek ini adalah disebabkan oleh semangat kuat saya untuk mempelajari pembinaan laman web e-dagang dan juga keminatan terhadap teknologi sistem pencadang. Dalam projek ini, sebuah prototaip laman web yang khas menjual barangan kemas telah dibina dengan adanya implementasi sistem pencadang. Sistem pencadang ini dibina berdasarkan sejenis algoritma collaborative filtering yang dinamakan sebagai ‘slope one’ algoritma. Cara algoritma ini berfungsi dengan mengunakan data tentang penilaian bintang pengguna lain terhadap sesuatu produk dalam sistem untuk meramalkan keminatan pengguna yang baru. Setelah prototaip ini dibina, prototaip ini telah dinilai dari sudut pandangan para pengguna dan keputusan penilaian ini telah dibincangkan dalam projek ini secara terperinci. Akhirnya, kesimpulan tentang cara untuk memperhebatkan sistem ini telah dibuat.

Kata kunci: sistem pencadang, e-dagang, collaborative filtering, slope one, barangan kemas

CHAPTER 1: INTRODUCTION

Introduction

E-commerce is a fast gaining ground as an accepted and used business paradigm. More and more business houses are implementing web sites providing functionality for performing commercial transactions over the web. It is reasonable to say that the process of shopping on the web is becoming commonplace. However, people tend to confused because of a great deal of products being sells online nowadays. Undeniably yes, all kind of products we can obtain through online. But can people really get what they need during the searching process? Customer often needs to spend much time on finding suitable products from a variety of products.

Based on this scenario, this project aims to develop an online jewelry store selling products with the use recommender system to provide customer the best personal online shopping experience. In this chapter we are going to discuss about the background of the study, problem statement, objectives, the significance of study and the scope of study.

Background

The Internet and the World Wide Web have revolutionized our daily lives and the way business is conducted. Since 1997, the Web has evolved into a true economy and a new frontier for business. In spite of what some observers refer to as the “Internet bust”. Web use for e-commerce continues to grow as many established brick-and-mortar businesses incorporate online components into their marketing strategies. A lot of company has started to create their own online shopping platform in order to let their products reach the global market. Through this platform they are able to sell their products all over the world to any country as long as there is someone there interested in their product. However, is it true that as long as the information of the products can reach the customer, the customer will purchase

it? As competition grows for online customers, companies cannot simply assume that if they build Web sites customers will come. Web shoppers have become more sophisticated in their knowledge of online purchasing alternatives, and more importantly, they have become less patient with Web sites. They expect to find what they need from a website in a short period of time and if they not, they can just simply leave because there are too much alternative website that selling similar products out there.

Based on this demand, many techniques are proposed to fulfil this requirement. One of them is the Information Retrieval (IR) (Chen et al., 2008). IR can execute users' command (such as keyword), find out the information or document from a massive database to match with users' demand and return the results back to users. One of the examples is the search engine. A lot of ecommerce website nowadays have implemented search engine for customer to search for appropriate products they want. However, the returning of customer's results includes too much irrelevant information. Consequently, customers must spend time to screen information one by one in order to find out their required information. The most distinctive characteristic of information retrieval is that users must initiate information request to play its role. Nonetheless, not all users can initiate information request very often; indeed, users expect to passively receive information provided. Hence, one other technique, called Information Filtering (IF) (Frias-Marinez et al, 2006), is proposed for complementing the shortcomings of information retrieval. Information filtering is another effective tool for mitigating information overload. Its principle of operation is based on analyzing user's behavior to acquire their preferences or interests and thereby to filter or screen out information they need individually. The difference between IF and IR is that information retrieval must passively wait for query command from users before proceeding further, in contrast, information filtering can actively assist users to find the relevant information they are interested in. One of the most common application that implementing this information

filtering technique is recommender system and therefore, recommender system has become very useful in all e-commerce platform because of the ability of providing information filtering, personalization, and satisfy the customer's preferences.

Problem Statement

Although recommender system can be a useful tool for online shopping platform, there is still lacking of real-world application of it. Perhaps the reason is because most of the companies are lacking of domain expertise or algorithm developing skill or some are because of lacking of massive inventory in the site. Therefore, most of the online shopping platform still unable to provide personalized information for the customer, in order to enhance their shopping experience.

This situation includes the industry of jewelry e-commerce. Jewelries are usually small decorative item wears for personal adornment. Usually are made of precious metals. Although nowadays there are a lot of online store which mainly selling jewelry products, there are few e-commerce platform which actually selling their jewelry products with the use of recommender system. Some company sells variety of products in their online store, some even until thousands of inventory available, but they did not provide any powerful tools to ease user for searching. It is difficult for user to search all over the store to look for the suitable or products that they would like. This situation motivated me to carry out this project to build an online shopping website selling jewelries with the use of recommendation algorithm.

Research Objectives

Therefore, the main objective of this project is to develop an online jewelry store selling jewelry with recommender system which able to predict customer preferences and provide recommendation base on their personal preferences. By implementing appropriate

recommendation algorithm in the online store, the system can provide product recommendations for every customer based on their preferences personally. This can eventually enhances users shopping experience and at the same time increase sales revenue for the shop owner. In order to achieve this main objective, there are several specific objectives that should be achieved first. These specific objectives are:

- To design an appropriate recommendation algorithm that able to predict customer preference accurately and provide with appropriate recommendation.
- To study a better practice of e-commerce website developing process.

Significant of Study

The potential contribution of this study can be divided into two aspects:

i) Knowledge

- Enhance the knowledge about development of a web based recommendation algorithms.
- Enhance the knowledge about online shopping application development.

i) Practical

- Provide user a personalized experience and excellent service when purchasing jewelry online.
- Create better revenue for company's online sales.

Scope of Study

The focus of the study is about implementing a recommendation algorithm into an online jewelry store. Instead of focusing on design and develop a high quality website, the scope of my study is about choosing a suitable recommendation approach and implement the

algorithms into the shopping application in order to provide users the best shopping experience. To build an online shopping site specifically site selling jewelry products, open source tools can be used. There are a lot tools and languages can be used to develop a website. However when comes to implementing an artificial intelligence (AI) system into website, the process become more complicated. This is because most of the AI system's development researches are built with the use of typical computer programming language. When comes to application of these systems into real world e-commerce platform, the method of development somehow having certain level of difficulty. Therefore, this project aimed to demonstrate a developing technique which is a bit different from typical website developing technique. Instead of just develop a typical online shopping application; this project is going to implement a collaborative filtering approach recommendation algorithm into the system.

Conclusion

This chapter aim to provide an overview for the intension for doing this project and the potential of contribution of this study.

CHAPTER 2: LITERATURE REVIEW

Introduction

This chapter focused on reviewing the trend of e-commerce and application of recommender system in e-commerce. E-commerce nowadays is not just about doing business online. Revenue and products is not the only thing that companies should concern about any more. Some details in the process of doing business such as customer experience should be take into consideration too when operating a business. In order to provide superior experience and satisfy customer needs, the application of artificial intelligence in e-commerce platform is getting more and more popular. Recommender system is one it.

In this chapter we are going to discuss about the existing approaches of recommender system, the study behinds it, pros and cons, and an experiment to compare their real world performance. This chapter also review the application of recommender system in the industry of jewelry e-commerce.

What is e-commerce?

Electronic commerce or e-commerce is a term for any type of business, or commercial transactions that involves the transfer of information across the Internet. It covers a range of different types of businesses, from consumer based retail sites, through auction or music sites, to business exchanges trading goods and services between corporations. It is currently one of the most important aspects of the Internet to emerge.

Ecommerce allows consumers to electronically exchange goods and services with no barriers of time or distance. Electronic commerce has expanded rapidly over the past five years and is predicted to continue at this rate, or even accelerate. In the near future the boundaries between "conventional" and "electronic" commerce will become increasingly blurred as more and more businesses move sections of their operations onto the Internet.

According to Smith (2014), there will be around $100 billion of online sales in the fourth quarter of the year in US. About 16% increase over the same period last year on pace with previous years. The diagram below illustrated the growth of US online retailer sales over these few years.

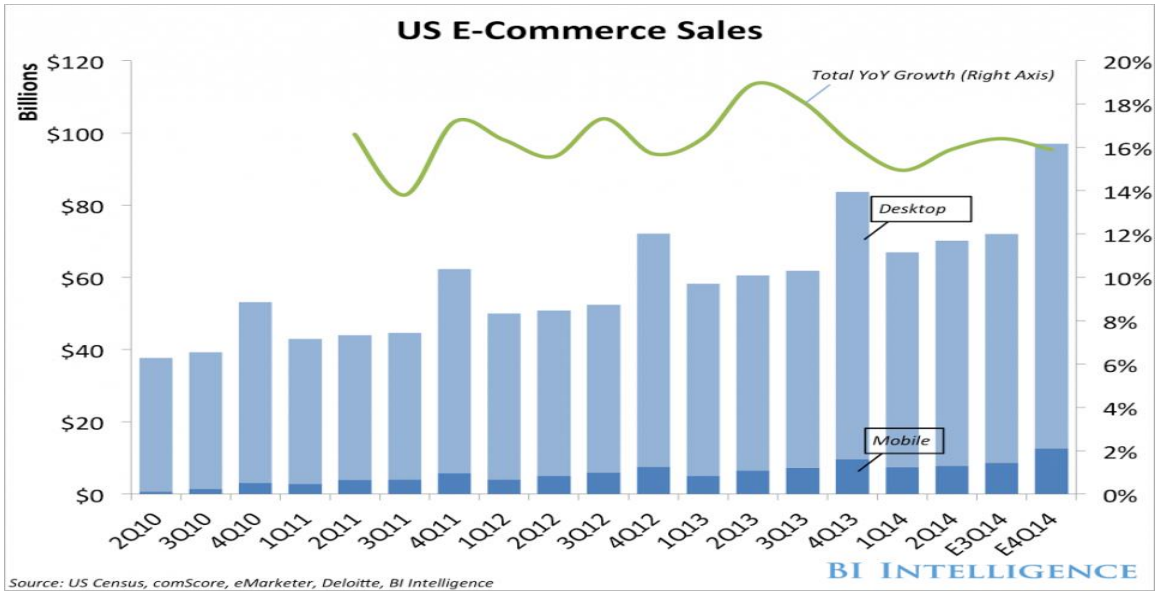

Figure 2.1: US E-commerce Sales (Smith, 2004)

Undeniably e-commerce has become the most mainstream trend for all kind of business nowadays. Therefore companies should emphasis on their own e-commerce platform trying their best to provide customer's needs and requirement in order to make better revenue.

Personalization of e-commerce

Personalization is a process of providing extraordinary treatment for the repeat visitor to a Website by providing relevant information and services based on the individual's interests and the contact of the interaction (Chiu, 2000). The earliest concept of personalization was introduced in the manufacturing industry. Actually, its name was usually treated as Mass-Customization in the early literature. With advances in technology, manufacturing cost reduces, and cost is no longer the only consideration. Therefore, the

industry introduced the concept of customization to apply in the service industry and to improve the service quality. Some researchers called this type of service as customization or personalization. Personalization is a concept of customization according to personal preferences. For example, amazon.com recommends registered members with relevant books and CDs according to their preference.

In other words, personalization puts emphasis on understanding customer's characteristics and grasping the real needs of customer. Indeed, the customer's satisfaction comes from the gap between expectation and real situations. Therefore, minimizing this gap is the crucial task for all companies. Weng and Liu (2004) had proposed the process of establishing the personalization from bottom-up (see figure 2.2). To actively provide customers with information or preference commodity, customer responses are measured to give feedback to other steps, and personal requirements are analyzed and recorded.

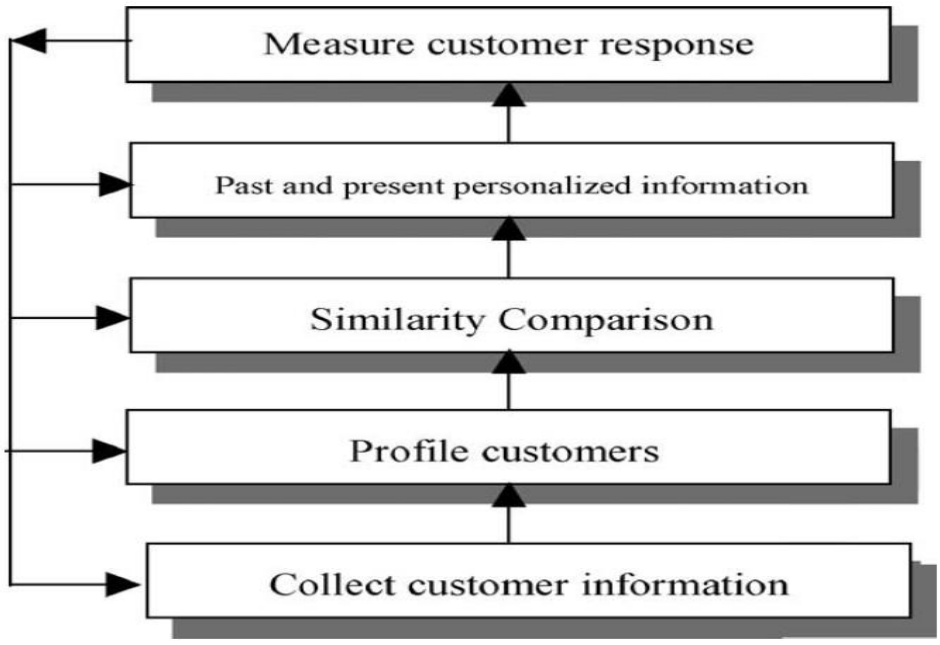

Figure 2.2: Process of Personalization **(**Weng & Liu, 2004**)**

As long as no privacy has been affected, personalized service is the key to attract customers. In order to provide expected products, raise service quality, and customer's satisfaction, customer's profiles including preferences, historical transaction data, purchasing behavior, etc., are analyzed. If companies able to adopt such concept and increase relevant service strategy, then their business will not only maintain existing customers but also attract new customers. In this way, companies will be able to increase its potential revenue.

Personalization technique

There are a few well-known techniques for personalization in e-commerce. Rules-based personalization which modifies the content of page based on specific set of business rules is one of it. Cross-selling is a classic example of this type of personalization. The key limitation of this technique is that these rules must be specified in advance. Another popular method of personalization which widely been used are content filtering method. Personalization that using this filtering method determines the content that would be displayed based on predefined groups of classes of visitors. One of the most famous application which applying this concept as the backbone of operation is the recommender system which widely been used currently in a lot of ecommerce platform.

Recommender system

There has been a growth in interest in recommendation system in the last two decades. The aim of recommender system is to help users to find items that they should appreciate from huge catalogues.

Items can be of any type, like for instance films, music, books, web pages, online news, jokes, restaurants and even lifestyle. Recommender systems help users to find such items of interest based on some information about their historical preferences. There are a few recommender system approaches been developed these years and all having significant

contribution to academia and this industry. Paragraph below will explain about these recommender system approaches.

Recommender System Approaches. Basically there are three common types of recommender system's approach:

- content-based approach
- collaborative filtering approach
- hybrid approach

These systems all have their strengths and weakness. The recommendation system designer must select which strategy is most appreciated given a particular problem.

For example, if little item appreciation data is available then a collaborative filtering approach is unlikely to be well suit to the problem. Likewise, if item descriptions are not-available then content-based filtering approach will be in trouble. The choice of approach can also have important effects upon user satisfaction. The designer must take all these factors into account when designing a recommender system.

Content-based Recommender System The main concept of content-based recommendation referring to recommending customers with the similar products they have purchased before. This technology mainly looks for the association of features between user profile and item attributes. First, the features of item attributes must be analyzed to determine and to compare the data on users' preference profile. Second, the process is to find out the commodities that the users are likely to be interested. Finally, provide services by recommending commodities to users (Weng & Liu, 2004)

Content-based recommendation is mainly extended from information retrieval, known as Feature-based recommendation. This is because this model emphasizes more on the

analysis of item attributes. Content-based recommendation is susceptible to retrieve content attributes, so it is more likely to be applied in the recommendation fields related to commerce, information, and education. With regards to e-commerce, the application fields may include personalized business services and mobile commerce (Schafer, Konstan & Riedl, 2001).

The typical architecture of recommender system basically covers several parts:

1) Data acquisition: Acquire users' preference feature data by the received information, historical transaction records, and website records.

2) Data Processing: Data are acquired by filtering or screening.

3) Recommendation Processing: Recommender model and initial threshold are generated from data comparison. The system may automatically adjust recommender model and initial threshold through the recommender procedures.

4) Recommendation Results: The results of system processing will be listed out and recommend to users.

Content based recommendation technology is often applied to the information-related fields including the analyzable content or description. It is easy to analyze because its content or correlation attribute is extractable. Such method builds the vector based on items' content or attribute. It usually applies the cosine of vectors to determine if there is any correlation between two objects. The smaller the angle between the vectors of two objects will be, the larger the similarity will be, and vice versa. Some famous systems application of content based recommender systems are described in the following.

1) NewsWeeder: NewsWeeder is a filtering system for Netnews which provides the interface of evaluating articles for user through Mosaic browser. The system compiles and analyzes

user's evaluation data to build user's profile and thereby recommend the unread articles to user by user be profiles.

2) InfoFinder: Acquire categories of users' preference through sets of messages or other online documents. InfoFinder differs from other content retrieval system. Its characteristics lie on using heuristic search techniques to acquire meaningful phrases.

The advantage of such system is the correct understanding of users' interests in the absence of document samples. Content based recommendation aims for commodities and therefore appropriate recommenders are beyond consideration. The following advantages provide more extensive applicability to the study on personalized recommendation:

(1) Recommend users without the reliance on other users' information.

(2) Provide recommendation based on the unique preference of users.

(3) Recommend new commodities to users.

(4) Give the reasonable explanation of recommending this commodity.

Content based recommendation may generate recommendations based on personal preference, and it doesn't need to rely on other similar users for the generation of recommendation. Therefore it is highly used for personalized services. However, the process of content based recommendation may encounter some issues.

First is its difficulty of analyzing multimedia projects. Most websites today offer the multimedia information, including sound, photographs, and video. The features of such multimedia could not be easily retrieved and difficultly compared for similarity. Besides, content based recommender system requires user's feedback in recommending process. The feedback information increase users' burden, so most users are reluctant to make the

informational feedback. Therefore, it will lead to the insufficient rating. As a result, this insufficiency will result in the lowering system efficiency. Furthermore, the common issue encountered by typical content based recommender is the problem of synonym and polysemy. Terms describing items usually contain synonym and polysemy. A recommendation adopting item filtering will be inaccurate without the establishment of sound word relationship (BalabaNovic & Shoham, 1997). The influence of users' interests is another issue for content based recommendation too. The prediction accuracy of users' interests will affect the recommendation results. If the recommendation system misinterprets users' interests, it will recommend the items that users are not interested at all (Montaner, Lopcz, & Lluis de la Rosa, 2003). The next issue is regarding new User (Burke, 2002). A new user didn't leave any usage records on the system before, and therefore no accurate and real-time analysis could be provided. Hence, the final recommendation results will be affected. It is unquestionable that many researchers have proposed good solutions such as ask some questions which might facilitate the discovery of users' preference upon users' first-time login to the system, or use other recommendation technology to prevent users from having untrustworthiness to the system and lowering the willingness to use. Content based recommender system only allow user to receive the recommended items similar from the past and couldn't find the correlation between the historical preference records of users and the object items to be recommended. Therefore, there is no flexibility to search for the potential preference. Last but not least, content based recommender system also encounters filtering limitation. Quality, style, or point of view of the same items could not be filtered. In the example of articles, such method could not effectively differentiate between the two articles that have the same title but the different content and quality.

To solve the above mentioned limitation of content based recommendation, a second system, collaborative filtering is used for the improvement. Collaborative filtering